POSITIVE CONTRIBUTIONS OF SCIENTIFIC MANAGEMENT

THE ELIMINATION OF SOME LOSSES CHARACTERISTIC OF PRESENT-DAY MANUFACTURE

SUMMARY

I. Introduction, 466.—II. Mechanical or Impersonal Aspects, 471.—A. Increased Production, 471. — B. Decreased Cost, 473. — The Use of Equipment, 475. — The Use of Labor, 477. — Material Control, 477. — Routing, 479. — The Regularizing of Production, 481. — C. Improvement in or Maintenance of Quality, 482. — D. Speedy Production and Accurate Delivery, 483. — E. The Power and Stimulus of Knowledge, 484. — III. The Human Factor, 487. — A. Industrial Peace, 489. — B. High Wages, 490. — C. Proper Working Hours, 492. — D. Conditions of Work as Related to the Health and Well-being of the Worker, 493. — E. Selection, Fitting and Training, 496. — F. Free Scope for Individual Initiative and Opportunity for Advancement, 498. — G. Reduction of Labor Turnover, 500. — H. A Spirit of Coöperation and Confidence, and a Feeling of Security, 501.

I. Introduction

Today, when present and impending conditions are trying men's souls and forcing a weighing in the balance of their past achievements in so many directions, it seems appropriate and important to make at least a partial appraisement of the contributions of scientific management to the field of industrial problems. It may be well, however, at the start to look back briefly over the successive stages of its development in order to arrive more fairly at a true estimate of its present value, and to enable a correct forecast of its potential worth as a means for the adjustment of present and future social and economic problems.

As long as the early discussions and the evolution of the science were confined within the bounds of the American Society of Mechanical Engineers, the public knew little of what was taking place. This was as it should have been, for the early papers [1] which stimulated discussion and really crystallized and forced the concrete statement of principles and methods, later served as the substantiation of the most potent claim of scientific managers — namely that scientific management is not a *theory* evolved on paper by a more or less practical dreamer, but is the result, tho as yet imperfectly expressed, of carefully worked out solutions evolved by far-sighted and eminently practical managers and engineers to meet everyday problems. Such theory as has been developed was preceded long years by sound practice.

With the Eastern Rate Case hearings in 1911, however, came the second stage, the public awakening; and immediately succeeding it came a flood of popular articles, extravagant claims, and vehement denials. There was a mad scramble on the part of various owners of industries (possessing a lamentable lack of understanding as to what this new movement really was) to secure this " panacea," and of course an equally eager readiness on the part of incompetent and frequently unscrupulous charlatans to supply the demand. It is safe to say that had not such abundant evidence of the real value of the fundamental *principles*, properly applied, been available during this period, the inevitable

[1] Towne, " The Engineer as Economist," Trans. A. S. M. E., vol. vii, p. 425; Towne, " Gain Sharing," ibid., vol. x, p. 600; Halsey, " A Premium Plan of Paying for Labor," ibid., vol. xii, p. 755; Rowan, " A Premium System Applied to English Workshops," Proc. Inst. of Mech. Eng., March 20, 1903, p. 203; Taylor, " A Piece Rate System," Trans. A. S. M. E., vol. xvi, p. 856; Gantt, "Bonus System for Rewarding Labor," ibid., vol. xxiii, p. 341; Taylor, " Shop Management," ibid., vol. xxiv, p. 1337. Gantt, " Graphical Daily Balance in Manufacture," ibid., p. 1322; Barth, " Slide Rules as Part of the Taylor System," Trans. A. S. M. E., vol. xxv, p. 49; Dodge, " A History of the Introduction of a System of Shop Management," ibid., vol. xxvii, p. 720.

reaction would have been much more severe and of much longer duration. The fact that it was not is only another tribute to the (possibly unconscious) far-sightedness of the real leaders in the movement.

For there is no question that the reaction is largely past and that we are now in the third stage. This does not mean, however, that there is not still a tremendous amount of misunderstanding as to the real significance of the movement, or even a considerable amount of active opposition. The third stage is again clearly reflected in the literature on the subject. The popular matter has dropped out pretty completely and has been replaced by an already large and constantly growing number of articles dealing, on the one hand with concrete illustrations and explanations of the actual workings of the system or of parts of it, and on the other hand with frequently altogether healthy and well-intentioned, tho unfortunately not always well-informed, attempts to appraise its true economic significance. The active and open opponents, failing to find proof of the fulfillment of their dire prophecies as to the ill effects on the workman and the heartlessness of it all, have largely been driven to a less outspoken if more insidious activity, unwittingly furnishing tremendous arguments for the extension of what they sought to kill through measures forced on misinformed legislators in a vain attempt to stop the inevitable.[1] And incidentally, those of the

[1] I refer to the anti-stop watch and premium-payment riders to the Army Appropriation Bills. Before the Committee on Military Affairs on January 4, 1917, Brig. Gen. William Crozier, Chief of Ordnance, in discussing the Taylor System at the Watertown Arsenal submitted testimony in substance as follows, Hearings before the Committee on Military Affairs, Army Appropriation Bill, 1918, pp. 955–964; see also Congressional Record for February 1, 1917, pp. 2654–60: —

After the Taylor System had been in operation at the Arsenal a year or more a comparison of identical jobs showed that the men on the average did 2.7 times as much work after its development as they did before. In the machine shop where most of these jobs were done, the average increase in output was 2.2. (See decrease for this department upon abolition of premium payment, below). The work was more carefully done, of a higher quality. There had been to date of testimony, January 4, 1917, some

Taylor persuasion — upon witnessing the constant putting forth, by those either ignorant of or actually opposed to the Taylor System as such, of "new" and brilliant ideas in management, incorporated long since in the practices of that group — may be pardoned for an unseemly chuckle up their sleeves at the rapid and irresistible spread of the principles and methods for which they have long stood. Not only in current trade journals laying no claim to being scientific management disciples, but also in the practices of many managers, some of whom at least lay claim to being exactly the reverse, is this tendency most noticeable. Only upon coming in more or less close contact with numerous plants is this fact brought home so forcibly.

We may say, therefore, that the sensational and propagandist period is past, that the foisting of half-baked "efficiency" schemes on an unsuspecting and over-eager public is rapidly passing (altho there are still, unfortunately, too many managers who give less attention to the selection of an industrial adviser than they give to the purchase of a new machine), and that the skeptical stage — the "my business is different" atti-

seven years after the system was inaugurated, no single instance in which a man had complained of overwork. The spirit and contentment of the men had never been so good as they were during the several years in which the system was in operation. For a number of years the average earning of premiums of the workmen, above the regular day wage which in itself was equal to that of other plants in the vicinity, was about 27 per cent of their pay.

By congressional action the use of the stop watch and the payment of premiums were abolished. A comparison of identical jobs done in many cases by the same workman both before and after this proviso went into effect shows in the worst case, that of a job done by the same man, that he took 4.2 times as long to do the work after premium payment was abolished; in other cases the ratios were 3.6, 3.0, 2.9, etc., with average ratios as follows:

Machine shop	2.2	times as long when not on premium
Foundry	1.6	" " " " " " "
Smith shop	2.1	" " " " " " "
Yard gang	1.8	" " " " " " "

The atmosphere of industry and application which was previously so noticeable changed materially, there was much more loafing and the men had no desire to exert themselves after premium payment was abolished. The earnings of the men of course dropped back to regular day rate, and the cost of manufacture was considerably increased.

tude — is gradually passing with the constant addition of new lines of industry to the list of scientifically managed plants,[1] and that we are now in a period of healthy growth accompanied by a much more sympathetic and truer understanding of the fundamental nature of the principles and problems involved. "Scientific management" has comfortably taken its place among the things which are here to stay.

It is perhaps a little early to attempt to judge of many of the economic problems raised by scientific management — the smoke of battle is yet a little too pungent, and we are not yet sufficiently removed from its beginning to enable us to get a true perspective of the movement as a whole. Whereas in the past, however, it has been necessary to speculate as to its *probable* effects on this or that phase of the problems presented, and even tho we may still justifiably concern ourselves in this manner with the numerous as yet unsolved questions, we can now, nevertheless, get a much clearer perspective than has been possible heretofore and perhaps more profitably focus our attention on the *positive* aspects and accomplishments in certain directions, realizing that it is no longer theory but facts with which we are dealing. If the writer succeed in crystallizing a few of the accounts on the debit side of our balance sheet by bringing together some of the concrete economic losses already eliminated or alleviated by scientific management, it may perhaps make easier our minds as to the state of the science as a whole.

In considering the effects of scientific management from the standpoint of its positive contributions to industry we may take up first the mechanical phase — the more purely impersonal aspects — divorced so far

[1] Cf. C. B. Thompson, "Scientific Management in Practice," Quarterly Journal of Economics, February, 1915, p. 262, in which eighty-three different industries are listed since which time there has been a noticeable increase in the number.

as possible from considerations of its direct effect on the individual, leaving the human factor as the last and most important topic. The two are to a certain extent interactive, yet sufficiently distinct to warrant separate treatment.

II. The Mechanical or Impersonal Aspects

A. *Increased Production*

Turning first then to the effects of scientific management on industry as such, as exemplified by those establishments directly affected by it, by far the most striking single fact is the *increase in production* it has effected with the same equipment and personnel. This has occurred in many cases to such an extent as to be almost unbelievable. Ten, twenty, thirty per cent increases are the rule, and an output twice or even three times as great as had formerly been secured is not uncommon. And these results have not been uniformly secured, as might be supposed, from plants that were near the lower level of efficiency before the development of the system was started. On the contrary, in many cases the standard of production was comparatively high, and I know of one case where the production was increased over 60 per cent in a plant which from every standpoint was previously generally considered to be absolutely the most efficient of its kind in the country. The desire for increased production is often, indeed, one of the minor causes for the management's determination to have scientific management — too often the output is greater than ever before and yet the firm through other causes is losing money, or conditions are unsatisfactory in other respects.[1] But in just that same plant when scientific

[1] Witness a recent demand on the part of workmen in one large shop for the initiation of time study as a means of mere accurate rate-setting.

management *is* developed, the output is almost sure to increase — incidentally as it were.

Increase in production has been the cry of economists for centuries, and for centuries they have had their cry answered — at least partially. For it is the exception where, take any industry you will, with the *constant substitution of new and improved labor saving machinery and equipment* the output has not been very largely increased over what it formerly was. Our industrial highway is strewn with the corpses of those individuals who would not or could not keep abreast of these improvements.

Such increases, however, altho they may enable the individual to survive, may not and often do not wholly satisfy economic demands. They are brought about by the *substitution* of new machines for those already in use, oftentimes long before the latter have earned their keep. I heard of a case where recently in one department, new machines costing thousands of dollars and having been in use less than one year, were scrapped to make way for new and supposedly superior machines.

The increase in production brought about through scientific management, however, is of a fundamentally different nature. True, the scientific manager does not tolerate obviously antiquated machinery, but he does not tolerate inefficient machinery of any kind, and it is just here that his real economic contribution comes in. With him it is not a case primarily of increase in production through new machines; it is first and foremost a case of increase through *getting the most out of existing equipment* and personnel. Only after present means are brought to their highest productiveness may the question as to whether new equipment is justifiable be satisfactorily determined. With the present mania for new equipment, we may well inquire whether, in very many cases, these changes do not impose an added rather

than a lessened burden on the consumer. If a proper charge for such rapid obsolescence as well as a regular charge for depreciation were figured into the expected cost resulting from the contemplated "improvement," and particularly if this expected cost were compared not with present costs with existing equipment, but with what those costs *should be*, it is safe to say that many new machines would go unbought, that many firms would avoid bankruptcy, and that the owners as well as the buying public would profit thereby. It is just here that the line between the two kinds of increases may be sharply drawn, which brings us to the consideration of the financial aspect of the question.

B. *Decreased Cost*

For all practical purposes the consumptive capacity of mankind as a whole may be considered to be unlimited. Yet not infrequently there has occurred a state of so-called "overproduction" in one or more widely consumed lines of commodities. This apparently anomalous state of affairs will be found, upon analysis, to be due not to overproduction as such — not to a simple cessation of demand because of satiated desire — but to a conviction on the part of the consuming public, that *at that price* under existing conditions the commodity in question no longer yields the demanded return for money invested in it. What was formerly exchanged for this commodity now goes elsewhere where the equivalency is considered to be more attractive. Lower your price on this one commodity, however, and see what happens: — the balance of equivalency just established is again disturbed, the commodity now immediately represents a relative increase in return, those articles which before replaced it are now themselves re-

placed by it, and we get back at least to the original state of demand with possibly an added demand. Continue to lower the price, and this commodity will continue to edge its way into favor, constantly disturbing the balance and in constantly widening circles continuing to replace other articles which we deem, in comparison, as of lesser utility.

It would then seem clear that a simple increase in production without at the same time a decrease in unit cost (and therefore, in the long run, in selling price) cannot of itself in the great majority of cases be considered an economic gain [1] and may at times lead to a direct economic loss — overproduction. Furthermore, a simple increase in production with an accompanying decrease in a cost which, due to inefficiency in management, was hitherto higher than it should reasonably have been as judged by modern standards, may not and usually does not wholly satisfy economic demands. It is only erasing the negative and getting back to par, as it were, but failing to add a plus.

Where the increase in production and the decrease in already satisfactory cost go hand in hand, however, our gain is direct and indisputable.

It was for this reason that the distinction above was drawn, and it is on this ground that scientific management may lay just claim to a more favorable economic judgment than the prevalent increase in production brought about through new equipment which may not be economically justifiable. With its insistence on present efficiency before new equipment is permitted, which with its accurate cost system furnishes a basis for determining the effectiveness of contemplated substitutions,

[1] I am not considering those rare instances where an increase in production with decreased cost may be an economic *loss* (in the case of whiskey, e. g.), nor where an increase in production even at a decided increase in cost may be a distinct economic *gain* (in the case of food shortage, e. g.). Such cases are altogether exceptional and have no practical bearing on the present discussion.

scientific management has a very much firmer foundation upon which to rest its claim. It of course has also the absolute reduction in cost in addition.

Of the various *means* by which scientific management increases production and decreases cost, some — such as the selection, fitting and training of the workers, the reducing of labor turnover, absences, lates, etc., the determining and securing of a proper day's work and the paying of a correspondingly increased wage — are distinct economic gains in themselves. These will be discussed under the human factors. Others, however, must be considered simply as the elements which go to form the most outstanding contribution of scientific management under this head — decreased cost — and as such several merit discussion here.

1. *The Use of Equipment.* Closely connected with the question of new equipment referred to above, is that of the full utilization of that now on hand, using the term in its widest sense to include all facilities of production.

A certain amount of idleness of equipment is of course unavoidable. That it should be even one-half of what it unquestionably is, however, is a striking commentary on the lack of foresightedness of many managements. The encouraging feature about it, however, is that a large proportion of idleness can be prevented and that a few progressive managers are informing themselves and taking effective steps to remedy the evil. Less encouraging is the fact that the extent and seriousness of the losses through idle equipment are seldom appreciated by the manager until it is brought forcibly, even violently, to his attention through cold figures. In comparatively few plants is a record of machine time regularly and systematically kept, and in still fewer instances is the effort made to determine in each case the exact cause

of idleness upon which to base intelligent remedies. If, as advocated by Mr. Gantt,[1] each manager could be shown that during the last two months a certain group of machines was idle say 40 per cent of the time, and that this idleness was distributed as follows:

TOTAL IDLENESS		40 %
Unavoidable breakdowns		3 %
Avoidable breakdowns		12
Lack of work at machines		15
Lack of orders for product	0	
Lack of materials	4	
Unbalanced equipment	6	
Poor planning	5	
Lack of help		10

and if in addition the money loss from each cause could be shown, measures to reduce the idleness would follow almost as a matter of course. Nothing is more common than an abundance of room in what was previously a very much crowded and overburdened department after steps have been taken to balance, rearrange, standardize and maintain equipment, and it is not unusual to hear of a whole contemplated addition to a plant being found entirely unnecessary and consequently abandoned upon the presentation of such statistics as those cited above — a direct saving of usually thousands of dollars, to say nothing of the avoidance of actual loss (through decreased production or increased costs) which many times occurs with an enlargement of plant.

Just why such conditions exist it is hard to say. Attention to such matters should be one of the main duties of the manager. And with a table such as the above, he would soon make them his principal duty. Yet, even

[1] H. L. Gantt, "Productive Capacity as a Measure of Value of an Industrial Property," Trans. A. S. M. E., 1916.

under present conditions, it seems so much easier to order new equipment, blame the seller for such slow deliveries that our production is held up, and overlook the fact that by the aid of such facts the way out lies right under our noses. The answer probably lies somewhere between our natural aversion to real thought and planning, and the fact that the prevalent forms of organization keep the manager so hemmed around with ordinary routine that he is left no time in which to conceive and execute manifest reforms. The exception principle in management emphasized by Mr. Taylor, merits a much wider application on the part of most of our executives.

2. *The Use of Labor.* Unlike an idle machine, there is of course no such thing as an absolutely idle man permitted in any plant, yet a man who, before thoro time study and planning might be considered to be extremely busy — as indeed he might be, tho perhaps inefficiently so — in the light of highly systematized working conditions would be thought of as having been previously very ineffectually employed. The term "idle" is becoming a relative one. In general, except as the human element, to be discussed, enters here, the same conditions as pointed out for idle equipment are applicable in this case, and for the present the two may be considered as of like nature and effect. Taken together they constitute the most tangible field for reducing costs.

3. *Material Control.* The stores system in a scientifically managed plant is typical of the minute control designed to be exercised over all departments of the work. It is designed to cover the four factors covering the efficiency of material use: Quality, Quantity, Time, and Cost, and great care is taken to maintain the proper balance between these four interdependent variables so that their resultant effect will be the best for any given case, all things considered.

It is not the purpose of this general review to go into a description of either the methods or the exact results of the various means by which modern management's economic contributions are made. To do so, even for the present topic, would require volumes. Only the broader features can be briefly touched upon. In general it may be said that the principal losses in the materials field occur on the one hand through oversupply, and on the other through undersupply; and curious as it may seem, losses from both sources occur most often in the same plant.

It is the exception where the cost of installation of the stores system does not pay for itself by immediate savings effected, and in many cases these savings arise largely through the elimination of surplus stock and useless varieties, and through effecting a more rapid turnover. In fact, reports as to the amounts of junk disposed of in various plants upon the development of the stores system would be almost unbelievable to one who has not had first hand contact with this work, were it not for the records supporting the statements. Tons and tons of supplies — ordered by the foreman for the expected rush which did not materialize, parts lost or rejected in process, duplicate orders uncaught, " rainy day " and spoiled parts cached by the workman, wrong material delivered and not sent back, parts for discontinued products, and fantastic variations from standard — all accumulate in the storerooms or at various odd places (including valuable working space) throughout the plant, until a detailed study of production requirements leads to a wholesale housecleaning. Immediately and almost invariably, the inventory of stores which it is necessary to keep on hand is decreased, releasing idle capital. This capital invested in turn becomes more productive through more rapid use.

The experience of the Watertown Arsenal where, upon the development of the system, the savings in one year resulting from the use of *surplus* stock amounted to $122,789.61 is typical of many, many plants in this respect. Similar instances could be multiplied almost indefinitely.

Looking behind such conditions we readily see not only the general disorganization and lack of knowledge thus typified, but also the large amount of capital tied up, the inevitable depreciation and deterioration of stock, and the general interference with the flow of work in productive processing. Add to this the elimination of the generally rapidly disappearing annual or semiannual shutdown for inventory taking, and the sources of the large savings become apparent.

Similarly, lack of the proper material at the right time is frequently the cause of expensive delays, postponed delivery dates and even loss of trade. Here again a certain amount of lost motion is unavoidable; but that four-fifths of the current inconveniences and losses experienced in material handling can be eliminated by detailed knowledge and proper planning is proved by those scientifically managed plants which have systematically attacked and regulated stores problems.

4. *Routing.* The decreasing of costs through the full utilization of equipment, of men, and of materials has been discussed. Another of the means by which this reduction is secured is the broader use and correlation of the business as a whole, including both the physical layout and the administrative control of the various component parts of the business.

Just what is meant by this topic, as well as its significance, may be illustrated by an example. In modern or scientific management a factory is looked upon from the

strictly production standpoint as comparable to an automatic machine. Just why this conception is necessary may be seen from considering a compound full automatic consisting of five successive components, A, B, C, D, and E. As a piece is completed in any one of these parts, it is automatically swung around to be further processed in the next, and obviously that next must be free of its previous piece and ready to receive the new. Properly to set up such a machine of course requires detailed knowledge of and strictest attention to the time element for each head.

Now, a great many plants are being run today without an appreciation of the fact that the various departments of the plant as a whole are exactly analogous to the various parts of the automatic machine. The result is very much like the result would be if the automatic were set up either by one man who lacked or disregarded knowledge of all parts except that he was working on at the time, or by two men working independently without the knowledge of what the other had done, was doing or expected to do. In the case of the machine its various parts simply must be correlated and brought into proper synchronism by one man or by concerted action if by more than one; the same thing is less obvious but equally true in the case of the interdependent departments of the manufacturing plant if equally satisfactory results are to be expected. The " set up " and regulation of the various departments of most factories is an exceedingly complex and technical undertaking commonly defined by the term " routing," and not for a moment can any one foreman be allowed to run his department as he sees fit regardless of its relation to other departments and to the business as a whole. Hence the insistence in scientific management on a somewhat elaborate Planning Department, or at least

on a central control of all activities which in any way have an interacting effect, and conscious and constant effort is put forth to secure this central control. As perhaps the finest example of the practical application of what has here been incompletely described, reference is made to the work of G. D. Babcock in the plant of the H. H. Franklin Manufacturing Company.[1] Suffice it here to emphasize the point that such control is the cardinal aim of every scientific manager, more or less perfectly realized in the best shops and secured through the systematic collection of all relevant information and through the practical application of this knowledge through measures collectively known technically as "control." This control is established through the proper use of such measures as standardization, time study, logical layout, careful routing of work and first-piece inspection, mnemonic symbols, the Order of Work and the Bulletin Board or its equivalent — all mechanisms which, in one form or another, have become integral parts of modern management.

5. *The Regularizing of Production.* Perhaps nowhere better than in the elimination of seasonal production and its attendant evils is the fact illustrated that what is of permanent benefit to the management also benefits the workmen, and *vice versa.* It would in fact in this case be difficult to say to whom the larger benefit accrues — to capital and the consumer through full and continuous use of a minimum of plant, equipment and personnel, or to the body of employees through full-time employment and regular wages. Operation under conditions of seasonal fluctuations is a direct economic waste to the community, and that in very many cases it is not an unpreventable waste has been amply proved by those industries which have attacked and eliminated

[1] Babcock, G. D., The Taylor System in Franklin Management.

the evil. It would of course be folly in this case as in so many others to claim any monopoly of effort along this line for scientific management plants — the case simply illustrates what may be accomplished along so many lines by what scientific management does make it a *definite policy* to do: a policy of conscious and continuous *taking thought* of the numerous economic and social factors which make for permanent success.

C. *Improvement in or Maintenance of Quality*

Next to increased output and decreased cost, the question of quality of output deserves attention, for obviously, while in cases improvement in quality may be justified even with decreased production and increased costs, the reverse would infrequently be the case.

That the increases in production under scientific management have not been secured at the expense of quality would seem proved, if proof were needed, by the permanence both of those increases and of the firms which have secured them, and will be questioned by no one acquainted with the facts. As a minimum, the maintenance, at least of the engineer's " good-enough-is-best " quality, must be the first concern of those who expect fully and permanently to benefit by modern methods of management. It has remained largely for the time study man and the instructor, supported by proper quality bonus and thoro inspection, however, to prove that as between speed and quality there is not only no intrinsic irreconcilability, but indeed that with intelligent handling an improvement in quality usually accompanies increase in speed. Just why this is so may be left largely to the psychologists — we are here dealing simply with the abundantly proved fact.

D. *Speedy Production and Accurate Delivery*

It must never be forgotten that any industry, to remain in operation, must produce a profit. When it ceases to do so it loses the support of the investor and must perish. As a corollary to this it must be borne in mind that investments in plant, in materials, and in labor become bills receivable only when the finished product is shipped from the factory door. This shipment date then becomes one of the vital points of contact between seller and buyer — the earliest point ordinarily at which *expense* becomes convertible into *profit.*

The quoting of a minimum time necessary for delivery after the receipt of the order and the strict adherence to the specified delivery date are two commonly unappreciated factors in business success. From the buyer's standpoint they are outranked in importance only by quality, and oftentimes not even by that quite frequently intangible and relative characteristic. As between two reputable firms whose selling prices are not at too wide variance, the duration and definiteness of the time for delivery become governing considerations, and not infrequently indeed delivery outweighs both quality and price. The firm which, on a basis of knowledge and through the systematic measures of control discussed above, can accurately predict and rigidly maintain delivery dates is not only in an enviable position from the buyer's standpoint but may claim a distinct contribution to itself, to the buying public, and to the community at large.

For every cessation of processing operations for lack of material, every delay due to machine breakdowns, every loss of production due to discontented or absent workmen — every interference with high production

from whatever cause in our factory — is an economic loss; every failure to meet scheduled and attainable delivery dates (regardless of whether thereby the purchaser's schedule is also upset for in any event *our* turnover is less rapid than it should be and our costs must be higher than they should be) — every performance below a standard which, as gauged by current and freely available modern practice, may be reasonably expected and justifiably demanded, is an economic loss which must ultimately be paid for by the consumer.

The quickening of production and the consequent increase in rapidity of turnover, the informed and detailed control of work in process, and, resulting from these, the quoting of a quick and dependable delivery date — these factors characteristic of properly managed plants together constitute a decided antidote to the tendency for ever increasing costs of living.

E. *The Power and Stimulus of Knowledge*

As a final consideration under the industrial or non-human aspects of the discussion must be mentioned, partially by way of summary, the numerous factors which considered as a whole form the possibly less tangible but nevertheless eminently comforting features of operation under scientific management. I refer to the confidence, the sense of security, the power and stimulus, the aplomb which springs from the knowledge that we have *real control* of our business through the ordered regulation of its activities according to adequate knowledge and best practice — one of those by-products of Scientific Management which are often of such transcendent importance.

There is something immensely stimulating about it all, something akin to the inspiration and confidence we

feel when in the presence of a man who is a master of his subject and whose opinions and actions we know are based on thoro knowledge and thoro understanding. Who has not experienced the enthusiasm which comes with the final solution of an intricate problem; who has not experienced the stimulus of directing interdependent forces in perfect confidence toward a solution which, be what it may, we know must be the proper one because arrived at through absolute adherence to natural law. In the one case it is the enthusiasm of the chemist when he knows he has ferreted out a new element; in the other it is the confidence and the power of the master at his work.

This enthusiasm, this stimulus is nowhere more infectious than in industry. Striking proof of this is afforded by the avidity with which the " efficiency " gospel has been bandied back and forth between adherents and opponents during the eight or nine years it has been public property, and by the readiness with which very many of the largest and most progressive firms in the country have accepted and successfully applied the principles of modern management. It is fortunate that this is so, for in the search for and utilization of better methods wherever found lies the hope of American industry. The metal working industry generally has been tremendously spurred forward not only by the development of high speed steel, but also by the example of those plants which have not been content with being forced to adopt this means of increased production but which have voluntarily followed this measure up with others of far-reaching importance, and who have thereby postponed in their cases the time of diminishing returns. Tho lacking the same stimulus, there are increasing signs that the textile and other industries are shortly due for a less revolutionary yet none the less peremptory

awakening. They also must catch up with the, as yet, comparatively few examples of advanced management among them.

The fear of the power of knowledge even more than that of the power of capital may well cause competitors to demand forthwith a balance sheet of knowledge. Tho capital is needed to put knowledge to work and to keep it there, capital without knowledge is likely quickly to disappear in competition with those who possess both. Knowledge without capital is a stronger asset than is capital without knowledge, for knowledge may be capitalized while capital cannot be educated. We may well pause to consider our probable future status when our competitor and not ourselves is one who knows how long work should take; who knows the capacity of each machine, of each department, and of his plant as a whole, and who takes measures to see that these various factors are properly balanced; who has worked out, standardized and reduced to permanent form the best methods of performing work; who really knows costs (as far as from their very nature they may be known) and knows at how low a figure he can sell in dull times and still make a profit or secure more work to keep his organization and plant intact even at no profit, and who knows when he does quote a specified selling price whether he is losing money on the sale or not. We may well consider our relative positions when he is the one who knows that there is no inherent inconsistency between wages plus and cost minus, because he knows, appreciates and acts on the fact that " maximum prosperity for the employer, coupled with maximum prosperity for the employee ought to be the two leading objects of management." Such a competitor, we know, really *controls* his business and has a check on its efficiency — we are but alchemists, he is the chemist of industry.

III. The Human Factor

Just as increased production may be frowned upon if unaccompanied by decreased cost of the product and either of these may be censured if thereby quality is allowed to suffer, so none of these accomplishments can be commended or tolerated if at the same time labor — the human element — be not kept in satisfactory adjustment and correspondingly benefited.

Important tho it be for the country at large that we have high production and low costs, that we establish a strong industrial basis, it is of greater importance that while we are making *things* we do not forget that our first and infinitely more important duty is the making of *men* — of good citizens.

Scientific management has from the first been a storm center around which questions of labor have raged. Because of its effects in so many particulars on human relations it must continue to be so.

Time and space might profitably be given to showing how, in the evolution of scientific management, more and more emphasis has been placed on the necessity of maintaining just human relations and of promoting the best interests of all concerned; how the very structure of the mechanism itself is designed to safeguard, to increase and to satisfy those interests; how its very nature is such that, so far from militating against those interests, it is vitally dependent for its very continuance on a proper maintenance of them. Certainly such considerations must prove of vital interest and concern to anyone who deplores and looks beyond the present troubled days. Profitable and interesting as such a story might be, however, I believe it to be still more profitable and pertinent to summarize, even somewhat categorically,

some of the specific accomplishments known personally or through reliable authority which show in concrete cases the embodiment in actual practice of the theory and principles of scientific management. A theory may be ever so beautiful in the abstract; to judge of its soundness we must examine its results in practice.

Before turning to the discussion of concrete cases, it should be remembered that in considering the relations between industry as such and the individual, one is dealing with questions of tremendous significance and complexity. Many of the unsatisfactory conditions under which we work today are heritages of an age long past, just as many of the more satisfactory conditions today are in turn the successors to those once less satisfactory. The massing of workers, the economic dependence of the employee on the employer, the specialization of processes and the minute subdivision of labor, the aggregation and power of capital — the problems and ills of the individual arising through such factors have not, as is sometimes intimated, been brought on *by* scientific management; they are inherited problems and abuses with which, in common with other agencies, scientific management must deal. There is and can be no panacea for industrial ills — industry is not such a static thing as to make possible any such consummation. No movement can be justly judged from this standpoint — it must be judged according to the vigor and success with which it attacks and solves or ameliorates such unsatisfactory conditions as it may encounter under given circumstances. In the case of scientific management then, our inquiry must be, not whether it has completely solved partially unsolvable problems, but whether it is entitled as its exponents claim to be ranked as a movement which, as a cardinal principle makes a vigorous attack upon these problems

a definite part of its policy, and which is in fact, perhaps more than any other one agency contributing in a substantial degree to their satisfactory adjustment. It is from this standpoint that the following discussion is offered.

A. *Industrial Peace*

It would be impossible to say to what one feature the freedom from " labor trouble " characteristic of plants operating under scientific management has been most due. Certainly no one feature in itself has brought this about, and probably not any one feature has been most potent, for high wages is by no means everything for which the workman looks to the management. The absence of labor unrest is due undoubtedly to a combination of causes — to increased personal individual production and improvement in quality with the resulting personal satisfaction; to high wages unaccompanied by overexertion; to individual and impartial opportunity, assistance, recognition and reward; to an adequate machinery for the speedy adjustment of grievances; to conditions of work, of pay and of opportunity measurably better than the labor union in neighboring plants of the same type has been able to obtain and at the same time to an absence of ultra "welfare work " and similar measures which smack too much of paternalism and which tend, the workers feel, unduly to lighten the weight of their pay envelope. It is due to a spirit of coöperation — the " mental revolution " which is such a vital part of scientific management — to fair dealing, to a proper work environment, to a spirit of democracy, and to a feeling on the part of the employee that his best interest is being and will be looked after. It is due in fact, to the various factors discussed above and yet to be discussed considered collectively — it is inclusive of them all.

Summarize the causes as we may, however, the fact remains that in scientifically managed plants there has been remarkable freedom from the turbulent and distressing manifestations of industrial maladjustment characteristic of the last four years. It would be too much to expect that they could entirely escape the epidemic of industrial unrest, but it is extremely significant that, so far as is known through broad inquiry, such disturbances as have occurred have been of an altogether minor character, quickly and satisfactorily adjusted.

This fact is of preëminent importance at the present time. It is unquestionably *the greatest* contribution of scientific management — all the more so because secured, not as industrial " peace " was secured during the latter period of the war by governmental *suppression* of the disturbance of industrial conditions by either labor or capital, but by *coöperation*, justice, and fair dealing.

B. *High Wages*

It has sometimes been claimed that, in the cases of certain profit sharing and other measures, daily wages have been depressed below the market rate in the exact ratio in which profits were to be shared. Whether the claim is well founded does not concern us here. So far as the writer knows, this accusation has never been laid at the doors of Scientific Management. That it is not likely with justice ever to be is due to the dependent relation between daily wages and output. Starting with a current base rate of pay and the normal amount and quality of work customarily delivered by the operatives for that pay, scientific management first takes measures by which that production or that quality, or both, may be increased. Having thus provided the possibility of

higher and better production, it then offers, as a matter of justice as well as of necessity, a correspondingly increased incentive for its accomplishment, payable at once regardless of whether or not during any given period a profit is made on the business as a whole. Each is necessary to maintain the other, and the increased wage is solely dependent on and must follow immediately, not precede, increased output.

Increases in the earnings of operatives working under scientific management are too common and well known to need repetition here. Bonus percentages, above the prevailing market rate of wages, vary from 20 per cent to 40 per cent or higher depending on the character of work, and on the average are earned on from perhaps 70 per cent to 90 per cent of the jobs worked upon.[1]

That the more progressive managers are beginning to question the prevalent empirical bases of wage determination and to seek for a more satisfactory basis is evidenced by an attempt on the part of several of them to reduce to formulae the effects of various factors previously wholly neglected or only empirically estimated. Thus Babcock [2] takes into account the following factors:

1. Rate of production.
2. Cost of living.
3. Number of processes workman can do.
4. Years of connected service.
5. Fixed charges rate per hour which man has chance to modify.
6. Percentage of premium earned.
7. Late or absence record.
8. Spoiled work.

[1] For typical records see Hearings before Special Committee of the House to investigate the Taylor and other Systems of Shop Management, vol. iii, p. 1502; Congressional Record, February 1, 1917, pp. 2655–57; Thompson, S. E., "Development of Scientific Methods of Management," Trans. A. S. M. E., vol. xxxix, p. 123.

[2] Babcock, G. D., The Taylor System in Franklin Management.

9. Percentage of time under task.
10. Coöperation and conduct.

Such an attempt shows careful consideration of one of the three most important things for which the workman looks to the management: wages, conditions, opportunity.

Since the present paper is designedly little more than a synopsis of conditions as they are, it would be inappropriate to prolong it into a discussion of the various interesting social and economic aspects of scientific management as related to the wage question as a whole. It must suffice here to emphasize the undoubted fact that scientific management is leading the way both in the actual payment of wages higher than the general market level and in attacking some of the deeper fundamental phases of the problem.

C. *Proper Working Hours*

Mr. Taylor was one of the first to recognize and to prove the fact that overlong working hours are not conducive to high output, and that in very many cases hours of work may be sharply decreased *up to a certain point* and output increased simultaneously,[1] this point having to be scientifically determined for each class of work. The policy of reducing excessive working hours offhand, and of continuing thereafter to reduce them to a point not inconsistent with maximum gross output, has been consistently followed by his associates,[2] and scientifically managed factories as a body today are operating under at least as short hours as any other

[1] For instance, see account of his early work at the Symonds Rolling Machine Company, Shop Management, paragraphs 195–210. The same thing has happened in numerous other cases.

[2] See Thompson, S. E., "Development of Scientific Methods of Management," Trans. A. S. M. E., vol. xxxix, p. 123.

group of plants, while excessive hours on the part of any of them are unknown.

When one stops to consider it, it does seem rather remarkable, not to say significant, that scientific management presents such a uniform history of simultaneous increase in output, increase in quality, increase in wages, decrease in working hours and decrease in costs in those plants where it has been developed. Such is its record, nevertheless, in dozens of applications. It has ceased to be a novelty and is now the expected thing.

D. *Conditions of Work as Related to the Health and Well-Being of the Worker*

Looked at from a perfectly cold-blooded standpoint the return on the investment in the upkeep of the efficiency of the human machine exceeds that on the investment in the upkeep of the mechanical product. A moment's reflection will show why this must be so, for under proper conditions the human mind and heart delivers a *plus* which the inanimate machine is incapable of. From the entirely personal, selfish financial aspect, then, there can be no question that the very best condition for the employee is the very best condition for the owner of the business. And by the word "best" is here meant what is really best for the workman in the long run: wages neither too low nor too high, hours neither too long nor too short, general treatment neither too degrading through neglect or abuse nor too emasculating through ingratiation or paternalism.

From the purely economic standpoint, furthermore, this condition is equally true. It is economically wrong to allow the human machine to work under unsocial conditions of long hours, low wages, poor working conditions, unfair competition and lack of free scope for the

proper exercise of one's individual abilities, because under such unsocial conditions best results are not obtainable from human beings. A prematurely incapacitated workman, much more than an inefficiently employed one, is a direct financial loss to the industry and a direct economic loss to the community.

But it is particularly the social and ethical aspects of the question which I wish to emphasize. That the owners and managers of plants under scientific management recognize and capitalize that source of additional personal profit is true; that they consciously consider their economic obligations may or may not be true; but that they primarily and continuously have the best interests of their people at heart, not from any ulterior motives but because they are that sort of person, I believe can be doubted by no one who will take the trouble to visit them and their employees. They would otherwise never have achieved scientific management — for scientific management is distinctly a thing to be achieved; it cannot be purchased and it cannot be had or maintained without this attitude.

One would naturally expect, therefore, to find in such plants satisfactory conditions as regards accidents, health and sanitation, the speedy and impartial adjustment of grievances, and comfortable working conditions generally. The providing of such necessities follows almost as a matter of course. In addition are found also in varying degrees of completeness rest and recreation rooms, playgrounds, libraries, lunch rooms where necessary operated at cost, first aid hospitals, etc., on an unpretentious scale according to strict utility. Such measures, if initiated upon actual need and if properly regulated, are appreciated by the employees and express the good will of the firm toward them. Then, as a step further, there are the mutual benefit societies and

insurance and retirement funds which were initiated by Mr. Taylor very early in his work and which are very characteristic of plants following his lead as well as of many others at the present time.

There is another phase of this question, however, which is of much greater importance than most of the measures enumerated in that it affects the workman during his entire working hours while he is at the machine and for his entire life as a productive member of society. While it is important to provide means for caring for him during temporary sickness or disability and after he has ceased to be productive, it is at least equally important that his period of usefulness be safeguarded and prolonged through attention to his daily work. This is accomplished through the determination of " the best day's work that a man could do, year in and year out and still thrive under." The object of time study is just this — the determination of a proper day's work which, through allowance for rest and necessary delays, the workman may do year in and year out and thrive under. The setting of a task either too high or too low is equally shortsighted, since the object for which the study is made is thereby defeated. As a vital part of the determination of such a task is the investigation of the tiring effect on a workman for each class of work, investigations commonly described today by the term " fatigue study."

It is significant that the first " fatigue study " ever conducted in a really thoro and scientific manner, so far as the writer's records show, was performed over thirty years ago by Mr. Taylor as a part of his determination of a proper day's work.[1] Indeed, so far ahead of the time was he that, except as embodied in the routine of current time study according to the methods he and his

[1] Taylor, The Principles of Scientific Management, pp. 53–59.

associates developed and insisted upon [1] these early researches seem until very recently to have been generally overlooked until the admirable work of the British Health of Munition Workers Committee served again to emphasize their importance.

And, in closing the discussion of this topic, it may be stated that, in spite of the oft-expressed fears on the part of various estimable gentlemen that the so-called " speeding up " would result to the immediate or ultimate detriment of the worker, no authentic case of anything but beneficial results has been brought to light.

E. *Selection, Fitting, and Training*

It would be difficult to overestimate the advantage both to the individual and to the nation of a condition where each person could be engaged, under conditions satisfactory to him, upon work for which he is naturally best fitted. The misfits in industry are the causes of a direct loss of thousands of dollars annually, and of a loss of initiative impossible to appraise and of far greater importance. In the first place it is an economic waste to hire a workman who is not fitted for the work in hand. This waste is not always avoidable or even to be avoided under all circumstances, however. In the second place, after a man is hired he must be quickly trained to his full productiveness or transferred without delay to work on which this will be possible. He must in the third place, both for his own sake and for that of the management, be taught to do several different operations if possible (see Babcock's formula, item 3, page 491, above), and finally in the fourth place he must be given an opportunity to measure up to his full abilities as he proves, by

[1] See Merrick, D. V., " Time Studies for Delay Allowances," American Machinist, June 21, 1917, p. 1061 (and preceding articles) where carefully worked out charts show proper allowances for rest and delays under various conditions.

careful and impartial records, that he can assume increasing responsibilities. It is a direct loss to employ a man on work for which he not fitted, or to fail to take advantage to his full ability. The human scrap heap of discouraged, discontented and worn out men is but a sorry return for our modern industrial system.

If we believe that " for each man some line (of work) can be found in which he is first class," it imposes upon us the duty of acting in conformity with our belief. In addition it is sound business. Committed from early days to a policy of " scientifically selecting, training, teaching, and developing the workman," in plants adhering to this principle it is the customary thing, therefore, to find operatives who are now doing excellent work on their third, fourth, or even fifth trial after having previously been unsuccessful at work for which even they originally thought they were best fitted. We naturally expect to find, and do actually find, numerous cases of promotion from the ranks. Starting with the original functional foreman inappropriately called the disciplinarian, now developed into the modern functionalized Employee's Department (known variously also as the Personnel Department, the Labor Department, the Employment Department, etc.), there is set up not only a means for bringing to pass such conditions as those described above, but also a means to establish and maintain a more intimate personal touch between management and men, and to modify or counteract the tendencies on the part of the foremen and the production officials generally to press for high production regardless of the best interests always of the individual, and on the part of the employees to go to the other extreme. This department is so constituted that it sits in judgment over the employee on the one hand and the management on the other — acting as buffer, as it were,

between the two. The very recent widespread adoption of this safety valve is a decided step in the right direction and has far-reaching possibilities in capable hands.

F. *Free Scope for Individual Initiative and Opportunity for Advancement*

" Democracy in industry " has been defined as existing where conditions are such as described in the above title. Whether we agree that this is a sufficiently comprehensive viewpoint or not, certainly this degree of " industrial democracy " should constitute the minimum for which we should strive, and is necessary for true progress. And yet even this amount is extremely difficult to obtain in modern industry, even with the best intentions in the world. Opportunity may be abundant, yet there are so many unmeasurable elements to be considered in determining advancement — so many questions of judgment and of personality and of circumstance. The best one may do is to do the best he can, in fair-mindedness and in impartiality.

Monotony, where monotony exists (for there is ample evidence that many for whom in their " deadly monotonous " tasks we are prone to feel compassion, do not at all envy us with our larger responsibilities), is due not so much to the unvarying repetition of recurrent operations as to the accompanying feeling that the work holds no future possibilities. Introduce the possibility and the probability of a more attractive future, and the humdrum task becomes but a stepping stone, seen in its proper relation to the whole scheme of things and eminently serviceable and satisfactory as a present means. The belief that each of us has a marshal's baton in his knapsack is no less stimulating today than it was

in Napoleon's time, and the conviction that we have reached a position of status is no less deadening.

Difficult as it is, therefore, it is nevertheless vitally important that the channels of advancement be kept open and that every incentive and opportunity be given a man for bettering his position. As possibly the most effective avenue through which this is accomplished in scientific management is functional foremanship. The requisites of the customary "line" foreman are so numerous and of such a nature as to preclude from that position all but the rather exceptionally gifted workman. Functional foremanship, by dividing among several foremen the duties ordinarily expected of the one, introduces greater opportunity for the man of limited or specialized talent and at the same time does not lessen the demand for those of greater or more balanced capabilities.

For the most part, since this topic is so closely allied to the preceding one where the provision for definitely teaching and guiding the employees was discussed, little additional emphasis is needed here. Before passing on, however, a prevalent fallacy in regard to the limitations placed on personality in these plants should be noted. The idea is frequently expressed that in working under highly standardized conditions and with detailed instruction and supervision from above in regard to methods, there can be little chance for the exercise for one's individuality.

I believe it has been conclusively demonstrated in practice that scientific management is decidedly a *dynamic* movement, governed not by inflexible methods and case-hardened mechanisms, but solely by *principles*. There have certainly been new developments from time to time sufficient to prove that there is a ready acceptance and adoption of better ways immediately they are

proved. But, and here is the point, they must be *proved*; for it is no less a waste to be constantly upsetting carefully worked out methods upon the insistence of those who, because they have not first mastered present ways, have little right to an opinion at all as to their relative efficiency, than it is to refuse to adopt new and better ways when they are found. We do not and it is right that we should not let a novice tamper with a new and delicate mechanism until he has proved that he has mastered it.

The complaint to this extent, therefore, is well founded. It is not individuality and initiative run wild, however, which is really constructive; it is intelligently applied individuality, and prerequisite to this is an understanding of things as they are and why they are so. Founded on laws based so far as possible on *fact* from whatever competent source obtained, and administered through a democratic form of organization which draws its various functionaries from the ranks of the workman, scientific management embodies "management sharing" on a basis and to a degree infrequently encountered in industry today.

G. *Reduction of Labor Turnover*

It is unnecessary to review either the extent or the evil effects of undue labor turnover. Much has been written on the subject, recent experience has made us familiar with its prevalence, and but brief discussion is necessary here.

Much of the restlessness in industry is curable. It is due to the existence of unsatisfactory conditions in just those features of management discussed in the preceding topics — to low wages, to long hours, to poor working conditions, to lack of proper selection, fitting, and

training, and to a conviction on the part of the employee that for him his present job in his present place offers no future. Naturally, therefore, with the removal of the causes in any particular place the evil itself largely disappears. This has been the experience in numberless plants which have adopted advanced measures more or less completely, and the testimony to this effect is in nowise limited to the particular group of industries we are here considering. The simple fact that their adoption with the accompanying low labor turnover are characteristic of scientific management plants to a high degree, as is proved by their records, is what primarily concerns us at present. Altho the amount of turnover has increased probably without exception during the last three years, it has noticeably been kept within bounds, comparatively, in plants of this type. Upon the introduction of labor-saving devices and methods where increase in sales has been insufficient to enable the retention of the whole previous force, the policy has been adopted of securing an eventual net reduction in personnel, through filling the places of those who voluntarily leave, from the ranks of the resultant force trained, as before mentioned, to perform several different operations.

H. *A Spirit of Coöperation and Confidence, and a Feeling of Security*

As a result of all of the positive products of advanced management enumerated above come the last and most important of them all. Indeed so important is the spirit of coöperation and confidence and the feeling of security on the part of the whole personnel that nothing should be allowed to undermine them; for without them, altho a certain *efficiency* may be obtained, true *scientific management* is impossible.

Coöperation may be obtained only by securing the confidence of those with whom we deal, and this confidence in turn results only when each man feels secure in the belief that he is in the best possible place for him and that he need have no fear for the future as long as he fully plays his own part.

Needless to say a feeling of security is not engendered by rate cutting, by low wages, by long hours and poor working conditions; it does not spring from paternalism nor from leaving in the hands of the foreman — the most directly interested party — the arbitrary power of promotion, reprimand, demotion or discharge with the often resulting nepotism and favoritism, not to say despotism. A sense of security is not furthered through a feeling on the part of the operative that not only is his training, development and guidance neglected by the management, but that even tho he may try hard himself, there is yet little chance for him to secure just recognition. An overemphasis of the profit motive does not lead him to feel that he will not some day be forced to choose between the employer and his own self-respect or his own best interests. Security does not accompany such conditions.

Confidence and an open mind is not established through haphazard methods of manufacture (for which the capable workman at heart has a profound if respectful disgust); low wages and high costs, which he knows are unnecessary, do not impel respect for the management, when he knows they are caused by the nonuse or the misuse of equipment, of labor and of materials which he sees about him and which he knows it is the management's responsibility to remedy. Industrial strife does not inspire in the workman confidence in a management which, as he knows, usually brings it on through shortsighted or selfish dealings. No great

respect for the ability for his leaders is awakened when he realizes that they know less about what constitutes a proper day's work and how to bring it to pass than he does — when, in other words, the leader knows less in this respect than the led. Only when the management really assumes its full share of the work and the responsibility may his confidence be secured.

And only through making this security and this confidence an actual fact has scientific management been able to produce what it so highly prizes and what it has so remarkably obtained — true coöperation.

We may thus distinguish several marked characteristics and accomplishments of Scientific Management. The first is its stability — the fact that it has progressed through the stages of novelty and exploitation to that of permanence. The second is its marked contributions to purely economic factors such as increased production and decreased cost, improvement in quality, a more rapid capital turnover, and the stimulus to industry in general resulting from the sound foundation of knowledge on which it is based. The third is its equally striking but far more important contributions to the field of human industrial relations in the success with which it has maintained industrial peace, increased wages, improved working conditions, established proper employment and training facilities, stimulated and provided for a larger individual opportunity, reduced labor turnover and secured true coöperation between management and men.

Such are some of the notable constructive accomplishments of the science of management in the field of industry during the thirty years or less of its development.

HENRY H. FARQUHAR.

BELMONT, MASS.